LUBRICATION

A Technical Publication Devoted to the Selection and Use of Lubricants

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Power Equipment Lubrication in Commercial Buildings

IN CERTAIN phases of commercial building operation, equipment in addition to that strictly confined to the generation of power will be involved. For example, there will be refrigerating machinery where foodstuffs or fur storage is necessary; air compressors or blowers will be required wherever any extensive circulation of air or operation of pneumatic tube systems are entailed, as in many department stores; and elevating equipment such as elevators or escalators will be found in some form in practically all commercial building service.

PART II
Refrigerating Machinery

Lubrication of refrigerating machinery is exceptional in that we must consider the action and effects of the lubricants upon parts not requiring lubrication, as well as upon the actual wearing surfaces. As a result considerable care and judgment must be used in selecting the lubricants.

Oil in any part of a cooling system may tend to reduce refrigerating efficiency due to its becoming so sluggish under the low temperatures involved as to form an interior lining in the expansion coils and materially affect the heat transfer.

LUBRICATING SYSTEMS

Splash and pressure lubrication predominate in refrigerating compressors today. The latter is suited for the lubrication of both vertical and horizontal machines. The former, however, is more adapted to the vertical compressor. The system involved for the lubrication of compressor cylinders, stuffing boxes and enclosed bearings will have a decided influence upon the grade of the oil that should be used.

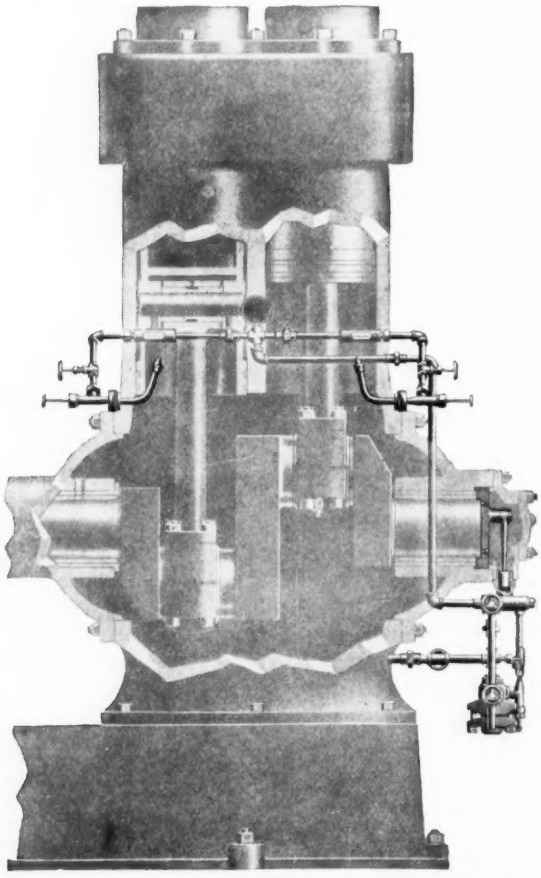
Splash Lubrication

Splash lubrication constitutes distribution of the oil at each revolution of the crank, the level in the crank-case being maintained just high enough to permit the crank to dip and splash the necessary amount of oil to the cylinder walls, etc. Continued operation will result in the crank-case being filled with a lubricating vapor above the main body of oil which will insure adequate lubrication of main, wrist pin and crank pin bearings as well.

Careful attention is necessary, especially when recharging the case with oil, to see that the level is not raised too high. The result would be churning by the crank, bringing about such violent agitation in the main body of oil as to oftentimes preclude effective precipitation of any impurities that may have gained entry. There would also be possibility of loss of lubricant past the piston rings with subsequent entry of an excess of oil into the condensing and evaporating parts of the system.

Another point in this regard is, that where piston rings are not sufficiently tight, if the

crank-case contains too much oil or agitation is too violent, the excess which naturally will reach the cylinder walls will tend to work past the rings, just as occurs so frequently in an automobile engine. This is often termed oil



Courtesy of Baker Ice Machine Co., Inc.

Fig. 1—Phantom view of a vertical refrigerating compressor involving force feed lubrication. Note pump driven from crankshaft, and details of piping layout.

pumping. Not only is it wasteful, but especially in an ammonia compression system will it be a detriment, for oil in the refrigerating lines will impose an added load on the oil separator.

Use of excess oil in a splash lubricated system will also involve the possibility of difficulty when draining and cleaning, especially where sludging has taken place. Churning of many oils will give rise to sludge formation if they have not been very highly refined. In part this is due to oxidation, and it will be more apt to occur if water is present or the oil is laden with very much foreign matter such as dirt, metallic parts or carbon. It is therefore important to observe regular periods for cleaning and to look carefully into the condition of the used oil for this will very often indicate both the approximate suitability of the latter and the extent to which effective lubrication is being attained.

Pressure Lubrication

In many vertical and horizontal refrigerating machines, pressure lubrication is used with marked success. More accurate control of the amount of oil delivered to cylinder walls and compressor bearings is possible with such a system.

On the other hand, it requires more equipment, piping, etc., and entails frequent filling of reservoirs and more attention from the operator, than where splash lubrication is involved.

One of the chief advantages of pressure lubrication is the possibility of effective filtration or purification of the oil if it is to be recirculated.

Mechanical force feed lubricators are extensively used where compressor cylinders are to be pressure oiled. Excellent economy will be attained by regulating such lubricators so that just enough oil is delivered to maintain the requisite lubricating films, with the least amount of excess to drain off.

External Bearings

On many types of machines it is also good practice to lubricate internal and external parts individually. In other words, using the mechanical lubricator with perhaps three outlets for cylinder and stuffing box service, and an independent gravity or mechanical pressure circulating system for all external bearings.

Force feed lubricators are also adaptable to cylinder lubrication via the oil lantern, or oil recess within the piston rod stuffing box. By so constructing a stuffing box it is possible to operate the piston rod continually through a ring of oil. In this way effective rod lubrication as well as sealing against pressure are maintained.

CHOICE OF LUBRICANTS

Importance of the Pour Test

Perhaps the most important essential in regard to an oil for refrigerating machinery lubrication is that it shall remain fluid at the lowest temperatures to which it may be subjected during operation. These temperatures will be encountered in the expansion or refrigerating side of the system, or in other words, beyond the expansion valve. There are many oils which by virtue of their base and degree of refinement will not be able to withstand lower temperatures without congealing to a certain extent, depending upon the amount of wax that may be contained.

Congealment will mean that a film of oil may be deposited on the inner surfaces of the refrigerating piping, to form more or less of an insulator which will prevent proper abstraction of heat from the compartment or medium which is to be cooled. If this is allowed to continue it is evident that the refrigerating capacity of the system will be reduced and ultimately it will be necessary to clean out these congealed oil deposits.

Water an Objection

Relative to this matter of possible congealment, consideration must also be given to water. It is essential that the oil at all times be practically free from water, otherwise this will freeze if carried over to the refrigerator coils in which case it would probably remain in the system and result in a certain decrease in evaporative efficiency.

It is therefore necessary for the operator to use the utmost care in placing oil cans beneath snow-covered suction pipes, etc., or anywhere else where moisture might splash or drip into the contents. An excess of water can readily cause so much trouble in the evaporator coils as to necessitate shut down of the plant until this is corrected.

Flash Point Also a Factor

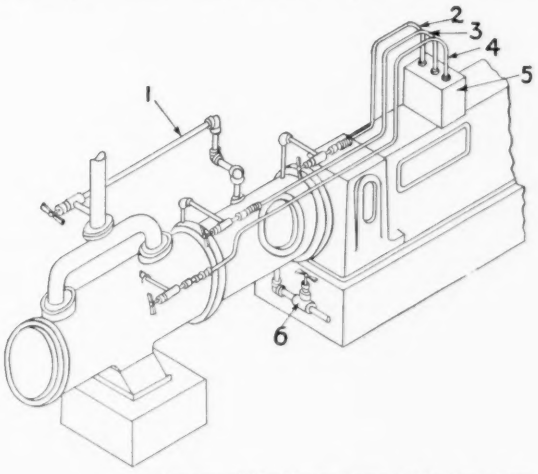
It is also essential at the same time that the oil have a high enough flash point at the pressure involved to insure against being carried over too rapidly at the discharge temperature. Flash point, in a wet compression system, is of less concern, inasmuch as discharge temperatures are usually considerably below those encountered in dry compression, and in both cases, below the flash point of the usually accepted ammonia compressor oil.

For such services a straight mineral filtered oil having viscosity of about 100 seconds Saybolt at 100° F. will be necessary where the temperature of the gas to the compressor is below 0° F. Above this temperature, however, an oil of somewhat higher viscosity, i.e., 200 to 300 seconds Saybolt, will give more satisfactory results.

Relation of Viscosity

In deciding upon the viscosity of oil to use, the physical condition of the valves, piston rings and stuffing boxes must always be considered. Practically as important as its lubricating properties will be the seal and compression-forming ability. If the cylinder wall and moving parts are in first class condition, a straight mineral oil of approximately 100 seconds to 200 seconds Saybolt viscosity at 100° F. will be suitable.

The more worn and scored the cylinder walls and rings, naturally, the higher must be the viscosity (within practical limits) to maintain the requisite seal and degree of compression. Usually an oil having a viscosity of 300 seconds Saybolt at 100° F. will be satisfactory in this event.



Courtesy of Worthington Pump & Machinery Corp. and The Carbondale Machine Co.

Fig. 2—Details of oil piping for double seal stuffing box on a Worthington horizontal compressor. 1, indicates vent from double seal chamber to suction; 2, is the oil feed to outer stuffing box; 3, the oil feed to inner stuffing box; 4, the oil feed to ammonia cylinder; 5, the 3-feed oil pump; and 6, the drain.

When enclosed crank-case, high speed machines of the wet compression type are involved, higher viscosity oils should be used which will stand considerable churning in the presence of the refrigerant and a certain amount of water vapor.

Horizontal compressor cylinders will have a greater tendency to wear out of round than those of vertical machines, due to the weight of the piston which must be carried on the under wall. Therefore, such compressors will, in general, require a somewhat heavier lubricant. It is not advisable, however, to attempt to compensate for wear by increasing the viscosity too much, due to the possibility of emulsification and contamination of the refrigerant.

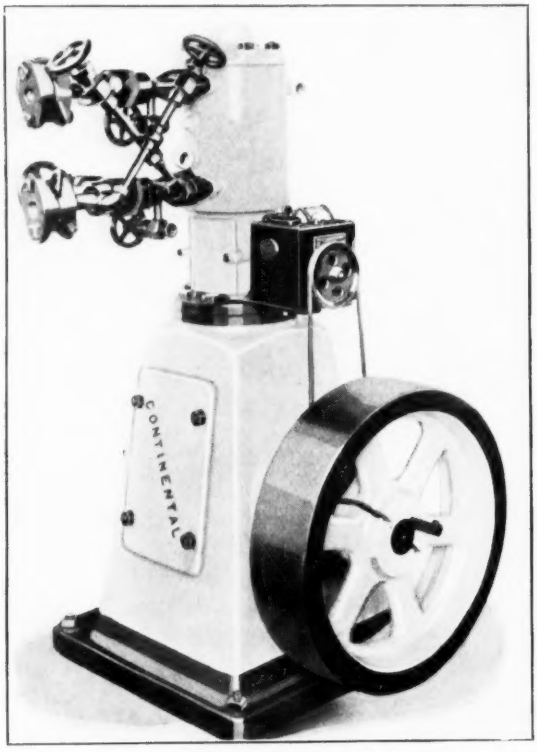
FEATURES OF MACHINE CONSTRUCTION

Function of the Oil Separator

Any excessive lubricant fed to a refrigerating compressor will tend to impose a heavy load upon the oil separator. The actual function of the oil separator is to remove any particles of oil from the refrigerant while it is in gaseous form, after it has left the compressor. The larger the oil particles of course, the more effective will be the separator.

Location

It should be located at a sufficient distance away from the compressor to permit of adequate precipitation of the oil within the ammonia gas. The capacity of any separator should be ample so that the velocity of the gas passing through will not be too high. In general, it should be placed between the discharge of the compressor, and where the gas enters the condenser.



Courtesy of Detroit Lubricator Co.

Fig. 3—Showing location and relative size of a mechanical force feed lubricator on a vertical type refrigerating compressor.

In certain machines, a purge valve may be installed under the condenser to enable removal of any oil that may have passed the separator. Where the oil separator fails to function properly, the reason is often because it is set too near the compressor and the rush of hot gas prevents proper oil condensation.

Atomization of the lubricant will practically always take place to a certain extent by virtue of the heat of compression which is prevalent, regardless of how high the flash point may be. This oil vapor will, therefore, tend to pass into the system with the refrigerant to condense and remain in the colder parts unless it is effectively removed before it enters the condenser.

Where it is impossible to locate the main oil separator elsewhere other than adjacent to the compressor, it is well to use an oil of as low an atomizing tendency as possible. Usually, low atomization accompanies high viscosity. The choice of the heavier oil would, therefore, solve the problem to some extent. In general, a viscosity of about 200 seconds Saybolt at 100° F. will meet these conditions satisfactorily.

Stuffing Box Seals

In ammonia and carbonic anhydride refrigeration practice, one of the most important factors is to maintain suitable stuffing box seals and properly lubricated piston rods. It is necessary to remember that ammonia has a certain corrosive action upon copper and bronze. Therefore, stuffing boxes are usually built of cast iron or steel (as are other parts of the compressor) and metallic (babbitt metal), asbestos, or rubber packing is used.

Function of the Oil Lantern

To lubricate the piston rod effectively in some types of machines, a hollow space or "oil lantern" is located between two separate sets of packing. This space surrounds the rod and is filled with oil. It also serves as a seal to prevent loss or leakage of ammonia.

The lubricant is usually fed to the "oil lantern" by means of a hand or automatic pressure oil pump. Where the piston rod is efficiently lubricated, its surface will have a smooth gloss, and will be covered with a light film of oil; there will be no indication of overheating and a relatively perfect seal will be maintained with a minimum of leakage.

Air Compressor Cylinder Lubrication

Air compressor lubrication is looked upon as an important problem by both the lubricating specialist and the power plant engineer. This chapter will treat solely with compressor cylinder lubrication. Other parts requiring attention in this respect will be practically the same in principle and operation as the so-called external parts of the reciprocating steam engine which were discussed in our January 1927 issue.

In the compression of air, work must be done: as a consequence, heat is developed, temperatures rising as the pressures are increased. The evolution of heat by the expenditure of work is a natural physical phenomenon. Machine operation in general brings about this occurrence to a more or less extent, depending upon the friction involved. Normally, however, such heat will have opportunity to dissipate itself

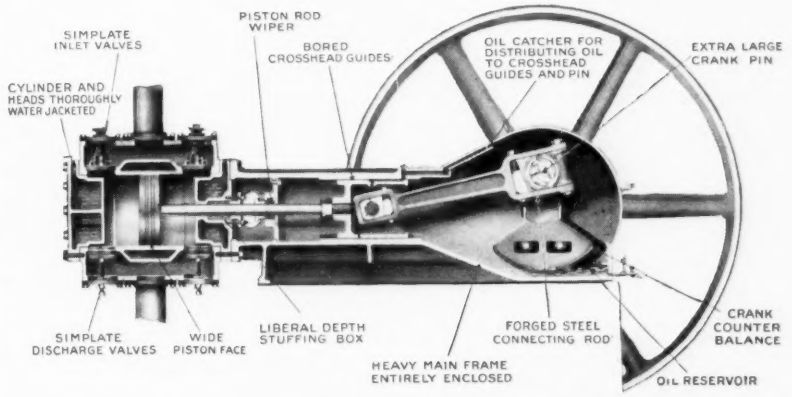
in some manner or other, either by radiation or conduction. In the air compressor, the heat developed is not a result of friction; it is, rather, the consequence of an increased rate of impact between the molecules of air composing the charge which is being compressed in the cylinder.

TYPES OF COMPRESSORS

In order to more fully appreciate the above, the basic constructional features of the several types of air compressors in use today must be understood. In general, we will be concerned with:

1. Single stage reciprocating compressors.
2. Multi-stage or compound reciprocating compressors.
3. Rotary compressors.
4. Blowers of the centrifugal or rotary type.

Single stage compressors or compressors subjecting air to but one compression, are built both single and double acting and may be either horizontal or vertical. They are used for the compression of air up to approximately 80 pounds.


SIMPLATE INLET VALVES
PISTON ROD WIPER
BORED CROSSHEAD GUIDES
OIL CATCHER FOR DISTRIBUTING OIL TO CROSSHEAD GUIDES AND PIN
EXTRA LARGE CRANK PIN
CYLINDER AND HEADS THOROUGHLY WATER JACKETED
SIMPLATE DISCHARGE VALVES
WIDE PISTON FACE
LIBERAL DEPTH STUFFING BOX
FORGED STEEL CONNECTING ROD
HEAVY MAIN FRAME ENTIRELY ENCLOSED
CRANK COUNTER BALANCE
OIL RESERVOIR

Courtesy of Chicago Pneumatic Tool Co.

Fig. 4—Sectional view of a single stage belt driven air compressor with oiling details and essential parts indicated.

Vertical, single-stage compressors are generally of the one-cylinder, single acting variety. The pistons in these machines are usually of the trunk type, the upper section carrying one or more rings which seal the cylinder and prevent excess oil from being drawn in or splashed since they are generally splash lubricated. The lower portions of such pistons usually carry one ring only. Vertical single-stage compressors are built in various sizes from one cubic foot capacity upward. Horizontal single-stage compressors are of the one-cylinder, double-acting type.

Multi-stage reciprocating compressors wherein air is subjected to two or more compressions, are used when pressures in excess of 80 pounds are desired. In compressors of this type, the air receives an initial compression in one cylinder. Passing through an intercooler which serves to reduce the temperature, it is then compressed in a second cylinder and so on in succession until the desired compression pressure is attained.

Because of the more effective cooling and because clearance losses are reduced, multi-stage compressors are the more efficient. Theoretically, therefore, the more stages the higher the efficiency, but size and cost of machinery, as well as frictional losses limit the number of stages to five at the most.

Rotary compressors differ widely in design, but as a rule use either sliding vanes rotating in an eccentric housing or rotating gears or cams so arranged as to alternately increase and decrease the enclosed air space. This type has not attained such general application as the piston type, both because of the complexity of the moving parts and the inability, as a general rule, to produce large volumes and high pressures as easily as the reciprocating compressor. In certain specific cases, however, the rotary compressor is quite efficient and the opportunity for future development is great; in addition, its lubrication requirements are less exacting.

Blowers may be of either the centrifugal or rotary type; they are built to supply large quantities of air at low pressures. The centrifugal fan blower consists of a more or less scientifically designed "paddle-wheel," revolving in an eccentric casing.

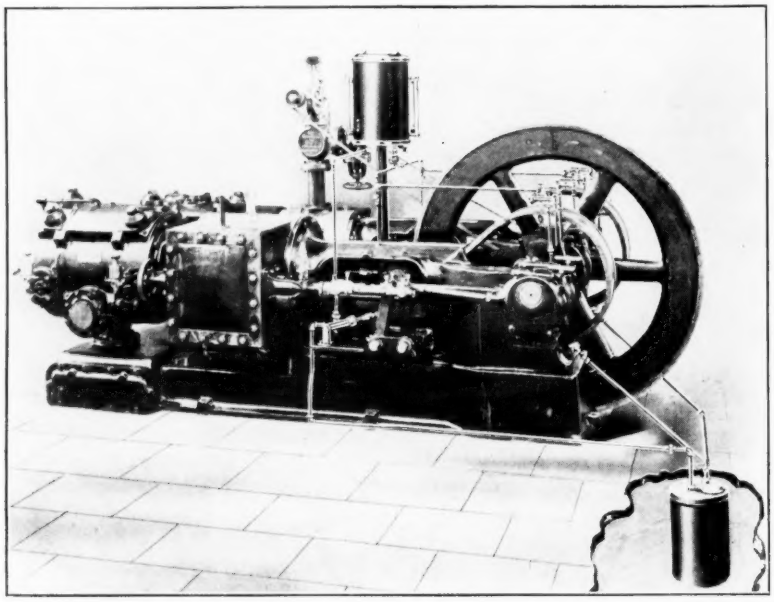
Blowers operate at pressures below one pound and are much used in heating and ventilating. Blowers of the bucket type develop along with the centrifugal action, a certain pressure due to the shape of the bucket or blade. They may often impart a velocity to the air in excess of the peripheral speed of the rotor. In the centrifugal machine, no lubrication of the air side is involved.

COMPRESSOR OIL REQUIREMENTS

The difficulties that will confront the operator in providing for proper lubrication of reciprocating air compressors are largely due to the possible extreme temperatures to which the oil may become exposed in the compressor, and to the fact that the oil on coming in contact with heated air, will tend to deteriorate, car-

bonize and become a source of subsequent trouble, if it has not been properly refined.

As in the case of steam cylinder lubrication, the condition of the internal surfaces, the piston speed, and the weight and fit of the piston must be taken into consideration in selecting the proper air compressor oil. Low speeds and heavy or loose fitting pistons require a higher viscosity oil than high speeds and light or tight fitting pistons.



Courtesy of S. F. Bowser & Co., Inc.

Fig. 5—Showing the manner in which an individual oiling and filtering system can be applied to an air compressor installation.

Other important factors which govern the lubrication of air compressors are, the extent to which the air is to be compressed, the location of the air inlet, the method of applying the lubricants, the kind of valves used, and the size and kind of water jackets, etc.

In the horizontal air compressor, as in the horizontal steam engine, the entire weight of the compressor piston must often be sustained by the lower portion of the compressor cylinder. With this type of compressor it is, therefore, necessary to use a lubricant which will have sufficient body at the temperature of compression to prevent metal to metal contact, and reduce wear to a minimum. Vertical compressors do not require as much or as heavy a lubricant as horizontal compressors.

To meet operating conditions as mentioned above, an air compressor oil must possess certain very definite properties if it is to function effectively and without undue possibility of developing into a hazard by virtue of subsequent decomposition. Broadly speaking, the essential characteristics which will indicate the ability of the oil to meet requirements are:

(a) The viscosity.
(b) The flash and fire points.
(c) The tendency to form carbon deposits.

Relation of Viscosity

In air compressor lubrication, the viscosity of the oil is a far more important characteristic than many will imagine. Upon the viscosity will depend the piston seal that will be obtained, and consequently the efficiency of compression.

If the oil is of too light a body, i.e., too low in viscosity, at the operating temperatures in the cylinder, it will work past the piston rings on the compression stroke. This, in connection with high flash point will ultimately lead to the formation of abnormal carbon deposits especially if such an oil has not been subjected to the most careful refinement, filtered, or is a product of an unsuitable grade of crude oil.

While an air compressor oil should have a viscosity high enough to sustain the weight of the moving parts, and form a proper seal between the piston rings and cylinder walls, it should never be so high as to cause reduction in atomization or involve excessive internal friction.

Moreover, if too heavy an oil is used, it will collect any dust that may be present in the air and will tend to bake on the hot surfaces and form carbon deposits. This is especially likely to happen when more oil has been used than just sufficient to lubricate the wearing surfaces.

Flash and Fire Points

While there has been considerable controversy among engineers in the past regarding the relative merits of high and low flash point oils for air compressor service, research has indicated a settlement of this point in favor of the latter. It has been proven that high flash and fire points have been decidedly over-emphasized in their relative importance as qualifications for air compressor lubricants. In fact, observation of the conditions under which explosions will tend to occur has further developed that high flash points may readily lead to the formation of deposits which are known to be dangerous.

In any installation, where such deposits are present and are rendered incandescent for any reason whatsoever, an explosion may occur irrespective of the flash or fire points of the lubricating oil. The operator can therefore readily appreciate that any worries he may have concerning the possibility of certain compressor oils being the more explosive, simply because their flash point is below the temperature of the discharged air, are unwarranted, provided that carbon deposits and leaky discharge valves are guarded against.

Carbon Deposits

Deposits of carbon plus dirt on the valves or in the discharge lines of an air compressor are to a certain extent caused by decomposition of the oil. It is an accepted fact that mineral lubricating oils, regardless of their base or nature, will decompose to volatile products and carbon when subjected to hot air under pressure.

The extent of this decomposition of course depends on the length of time the oil is exposed to such heat. Naturally, also it will follow that the oil which remains in the compressor cylinder or on the discharge valves the longest, will form the greatest amount of carbon.

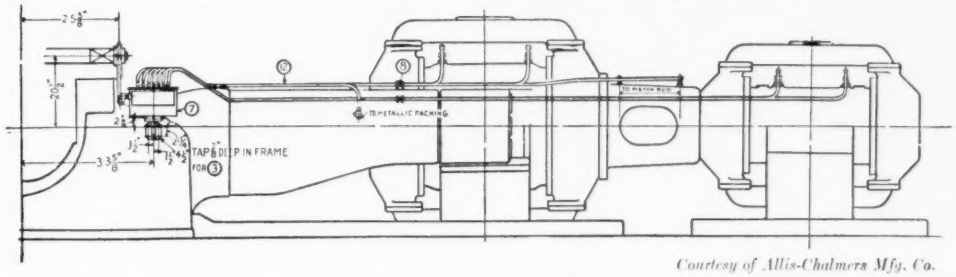
On the other hand, analysis of numerous so-called carbon deposits has proven them to consist more of dirt than of carbon, the whole being held together by gummy matter from decomposed oil. For this reason an oil having a wide range of distillation, high end point, or too great a viscosity is objectionable, inasmuch as, instead of vaporizing cleanly, it breaks down as has been mentioned above, becoming sticky and collecting dirt brought in by the air. The slower the breaking down process, or the greater the volume of oil involved, the greater the amount of carbon ultimately developed.

Carbon may be deposited in cylinders in a hard mass or it may be produced in the form of dust, to pass out with the air. In the latter case, it will often collect in pockets, elbows or on sharp edges and become mixed with dirt taken in by the air as well as with oil which has been vaporized in the cylinder, and later condensed at these points. When once started, such formations continue to build up, so narrowing the passage that pressures may be produced capable of eventually causing an explosion.

METHODS OF AIR CYLINDER LUBRICATION

Assuming that an oil to be used for air cylinder lubrication satisfies the requirements discussed heretofore, it is safe to state that the possibility of future difficulties due to carbon formation will depend upon the method of feeding the oil and the quantity supplied.

In fact, many authorities feel that this entire matter of efficient air compressor cylinder lubrication hinges upon the amount of oil used.



Courtesy of Allis-Chalmers Mfg. Co.

Fig. 6—Line sketch of oiling connections on a horizontal compressor. 7, indicates the mechanical force feed oiler. Essential oil piping is indicated by heavy black lines.

Any excess supplied over that actually required will involve one of two possibilities:

(a) That the oil will either be consumed by vaporization and breaking down in the compressor with the formation of a certain amount of direct carbon, or

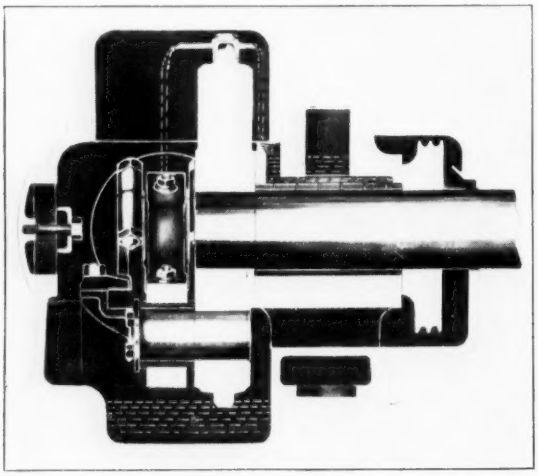
(b) That it will be carried over with the air to subsequently collect in the intercooler or in pockets elsewhere in the system.

As is the case with steam cylinder lubrication, the oil will function best where it is completely atomized prior to being delivered to the cylinder. To effect such atomization in small and medium-sized compressors, the oil is often introduced at or above the point of air intake, the inrush of air carrying the atomized particles or spray of oil to all parts requiring lubrication. On account of the lesser amount of oil involved, and the fact that a filtered oil is more readily atomized, the lubricator can in such cases, be located fairly near the intake as atomization is effected in a shorter distance of travel than where steam cylinders are involved.

Air, however, does not carry oil particles as readily as does steam. Horizontal compressors, therefore, may not receive sufficient oil at the uppermost parts of the piston and cylinder to insure satisfactory lubrication unless, of course, the oil feed is increased above the usual theoretical requirements. This is inadvisable, since

the bottom parts of a cylinder, being probably over-lubricated, will lead to the collection of oil in pockets, with ultimate carbonization or even the possibility of explosion.

In such cases, the better procedure is to feed



Courtesy of Ingersoll-Rand Co.

Fig. 7—Showing the main bearing of an air compressor, with means of lubrication employed.

the oil directly to the sliding surfaces by means of sight feed drip oilers or force feed lubricators. This, in fact, is customary practice in many installations. Oil introduced in this manner is distributed to the cylinder walls by the wiping action of the piston.

Automatic lubrication by means of force feed lubricators whereby the flow of oil to each part of the cylinder can be regulated, is perhaps the most efficient and economical method so far employed. By its use, the possibility of overfeeding oil by any particular lubricator is reduced, oil flow stops and starts with the compressor, and the requisite lubricating and sealing film is attained.

Force feed lubricators are not affected by variations in air pressure, and they will feed the oil continually in accordance with their adjustments and the speed of the compressor.

Different types of compressors, of course, will naturally involve certain variations in their lubrication; in fact, they may even require radical departure from what are normally classed as standard methods of lubrication. In general, however, the sight feed, hand regulated, or automatic (force feed) lubricator is used; the application, etc., being planned according to the recommendations of the compressor builder, based on the design of the machine, its size, capacity, and the character of the valves employed.

Certain of the latter, such as flap and plate valves ordinarily require no lubrication. Others, such as grid, Corliss and poppet valves require either direct application of oil, or will receive the requisite lubrication from the oil particles which are carried by the air.

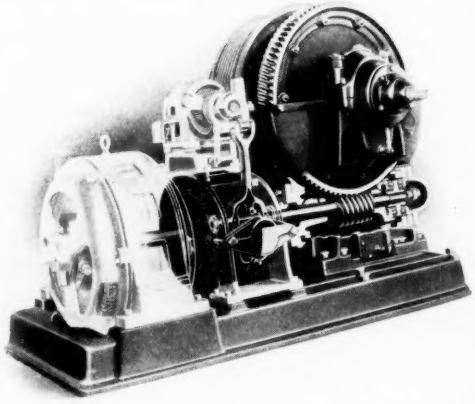
Amount of Oil Required

To attempt to establish any hard and fast rule in regard to the theoretically proper amounts of oil that should be supplied to an air compressor cylinder is never advisable. Too many variables, such as the size of the compressor, its speed, and the condition of the piston and piston walls are involved. Essentially we must guard against over-lubrication, inasmuch as more trouble may be caused by the use of too much rather than too little oil.

It must be remembered that the oil will probably remain in an air compressor cylinder considerably longer than in the cylinders of either a steam or internal combustion engine, owing to the fact that there is little or no washing action or dilution of the oil film involved. As a consequence, very much less oil will be required per unit of cylinder surface over the same time interval.

It is a safe rule to use just enough oil to prevent frictional wear and to permit easy and free operation of all parts; more than this will lead to trouble. If the lubricant is unsuitable, an excessive amount will be required to keep the pistons from groaning in the cylinders; in addition, the result of using an excessive amount of oil will be carbonization in the air passages, and particularly on the discharge valves.

Sticking of these valves, with the passage of hot compressed air back into the compressor cylinder, is practically a sure sign of too much

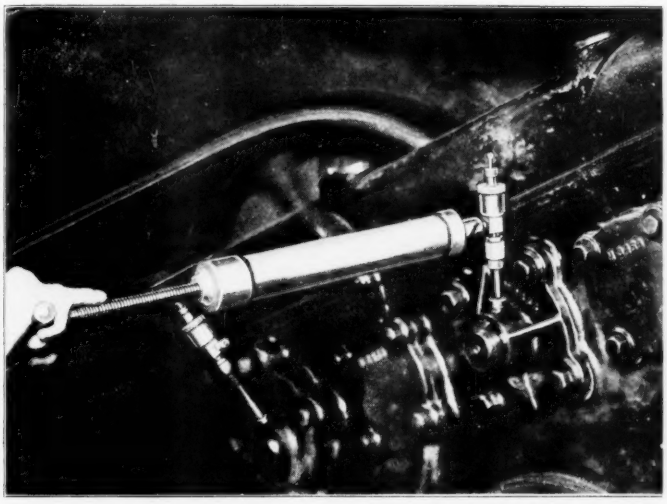


Courtesy of Otis Elevator Co.

Fig. 8—Phantom view of drive of an electric driven type of elevator showing in detail the relative positions of worm and gear, and the essential bearings.

oil. The discharge valves should therefore be examined regularly, and the after-cooler, receiver, or discharge pipes periodically blown out. This will effectively remove any oil, water or sediment which may have accumu-

lated. If upon removal, the discharge valves have a greasy appearance, enough oil is being fed to the cylinders; on the other hand, if the parts appear very oily or little pools of oil are found in compressor pockets, or in any of the air lines, oil is being fed in excess of that required.



Courtesy of Industrial Oil Equipment Co.

Fig. 9—Escalator bearings being lubricated by pressure grease gun and the Gun-fil constant pressure lubricator.

There is a general rule to the effect that air compressors are sufficiently lubricated if one or two drops of the proper grade of oil are used for each 500 or 600 square feet of cylinder surface swept by the piston per minute. This rule, on the other hand, must be governed by the condition of the cylinders, the temperature and the degree of compression.

The number of drops which can be secured from a certain amount of any grade of oil varies with the viscosity, temperature, service conditions involved and the diameter and shape of the lubricator orifice. In other words, the number of drops secured per minute from an oil having a Saybolt viscosity of 200 seconds at 100 degrees F. would differ from the number secured from an oil of 300 seconds viscosity. Also the type or design of lubricator, i.e., whether mechanical, force feed or hydrostatic, would affect the number of drops obtained.

Elevators, Escalators and Sidewalk Hoists

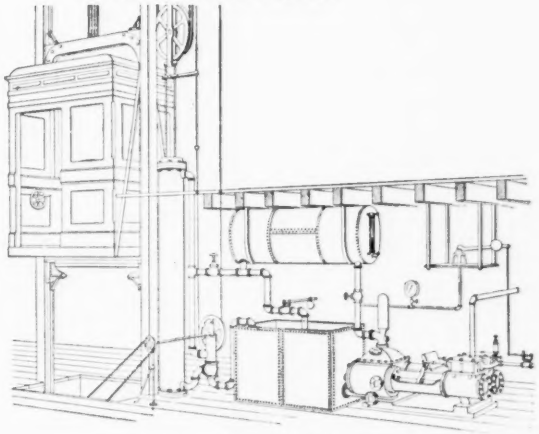
Lubrication of commercial building elevating machinery is unique as pertaining to the potential problems that may arise. Rarely will other equipment involving the same mechanical principles operate under conditions as severe as does the average elevator or escalator. With the former, repeated starting and stopping under generally heavy load prevails. With the latter, continuous operation for hours at a time is essential, with frequently no stand-by installation to fall back upon in event of breakdowns.

Continued operation for example, under the usual conditions of location and handling requires that lubricants for escalator service be very highly refined products, for they must endure dust, frequently considerable heat, and give extended service.

In turn, the geared traction type of electric elevator to meet its peak-load conditions will often function with its worm exerting a starting torque approximately three times the normal. To resist the resultant abnormal squeezing-out action between the teeth of the worm and gear it is evident that worm-gear lubricants for such service must be highly adhesive though comparatively fluid, have high lubricating ability, and be capable of flowing readily to their normal level in the case or to the pump as the installation may require.

Practical lubrication of elevator machinery can best be discussed according to the type of equipment involved, i.e.,

Hydraulic Elevators,
Electric Type Elevators, and
Escalators and Hoists.



Courtesy of Material Handling Cyclopedia Simmons-Boardman Publishing Company.

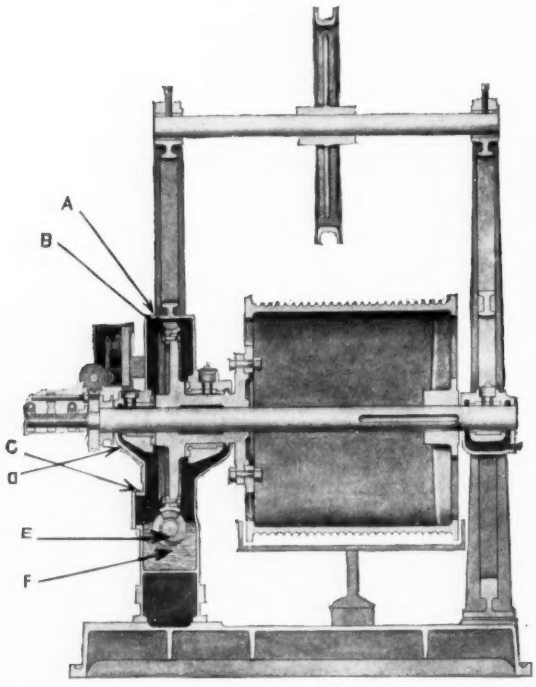
Fig. 10—General arrangement of operating machinery for an hydraulic type elevator. Note relative position of tanks, pumps and hydraulic piping.

HYDRAULIC ELEVATORS

Lubrication of such equipment is relatively simple, being confined to the plunger (or piston rod), the pumping system, sheave bearings, and control valve, etc. In the case of the first,

periodic coating with a high grade of pure mineral lubricant having a viscosity of about 1000 seconds Saybolt at 210° F. will insure free sliding through the cylinder stuffing box.

Pump lubrication is similar to usual practice



Courtesy of Turnbull Elevator Co., Ltd.

Fig. 11—Cross-sectional view of an electric drum type elevator. A, is the upper gear housing; B, the bronze worm wheel rim; C, the lower gear housing; D, the oil passage; E, the worm; and F, the oil reservoir.

in general pump operation. In a steam driven unit the selection of the steam cylinder lubricant is of importance. This should be a compounded product, of a high grade steam refined cylinder stock with 6% to 8% of fixed (animal) oil added to insure proper emulsification and sticking of the lubricant to the cylinder, etc., in the presence of moisture, which will usually be present.

External parts, such as rocker arms, etc., should be lubricated with a good grade of engine oil, of about 300 to 500 seconds Saybolt viscosity at 100° F., applied either by hand or by sight feed oil cups. Plungers or piston rods on the water sides of such pumps require no lubrication other than they naturally receive from the water itself, which is treated with an emulsifying compound periodically.

Water Treatment

The necessity for so treating the water used in a hydraulic system is to cause precipitation of fine grit and impurities held in suspension which would cause excessive wear on packing valves, etc. It also enables the water to contain in an emulsified state a certain amount of lubricant in order that the control valves, which are chiefly leather cups, will be kept in a soft pliable condition and not deteriorate too rapidly. Usual practice requires addition of this compound at bi-weekly intervals. Soluble oil will usually meet the requirements of such service.

Lubrication of sheave bearings differs very little from usual practice. Inspection and maintenance of lubricating equipment are most important. The lubricant to use should be a good grade of engine oil of from 300 to 500 seconds Saybolt viscosity at 100° F. Hand oiling is frequently the custom, but the use of sight feed oil cups or a chain oiling system is considered best practice.

Miscellaneous Lubrication

Other parts requiring lubrication in a hydraulic system include the controlling mechanism for the operating valves, and the guides for the counterweight and car. The former, if of rack and pinion type, should be preferably served with a good grade of gear lubricant of about 200 seconds Saybolt viscosity at 210° F.

On the counterweight shoes, etc., for insuring lubrication in the guides, grease cups are preferable, a medium bodied compression cup grease that will not drip or run off being the best lubricant.

On such surfaces there is no extensive pressure brought to bear, and the necessity of a lubricant is simply to insure perfect sliding contact and to overcome any inequalities of surface that may exist either on the shoes or guides.

ELECTRIC DRIVEN EQUIPMENT

The subject of electric elevator lubrication can be sub-divided into the treatment of electric traction gearless machines, traction geared machines, and drum type elevators. The essential differences will be in the hoisting mechanism. In the gearless type of traction elevator, the motor bearings and sheave bearings are the principal features. Construction will determine the manner of lubrication.

With plain bearings built for chain or ring oilers, the problem is simply that of keeping the oil wells properly filled with a good grade of engine oil, having a viscosity of about 300 seconds Saybolt at 100° F. On the other hand, certain types of machines that involve roller or ball bearings, require that either a light oil or grease be used.

Worm Gear Lubrication

Lubrication requirements of worm gears in a drum type or geared traction elevator, or an escalator involves probably the most important and exacting condition of all. A suitable lubricant for this purpose should possess certain qualities that do not usually pertain to other oils, i.e.,

(a) It should be of sufficient body to withstand the excessively high pressure at the point of contact, to thereby prevent actual metal to metal friction occurring between worm and gear.

(b) It should be entirely free from acids or alkalis which would tend to cause a certain amount of pitting on the metallic surfaces covered, particularly the polished steel roller or ball thrust bearings.

(c) It should not be materially affected by heat, water, acid or alkali.

(d) It should have as low a pour test as possible in order that it may be used in colder climates without abnormal congealment and excessive power consumption when starting is necessary under low temperature conditions.

Opinions of authorities on worm gear construction, operation and lubrication, differ as to the most suitable type of lubricant to meet the above requirements.

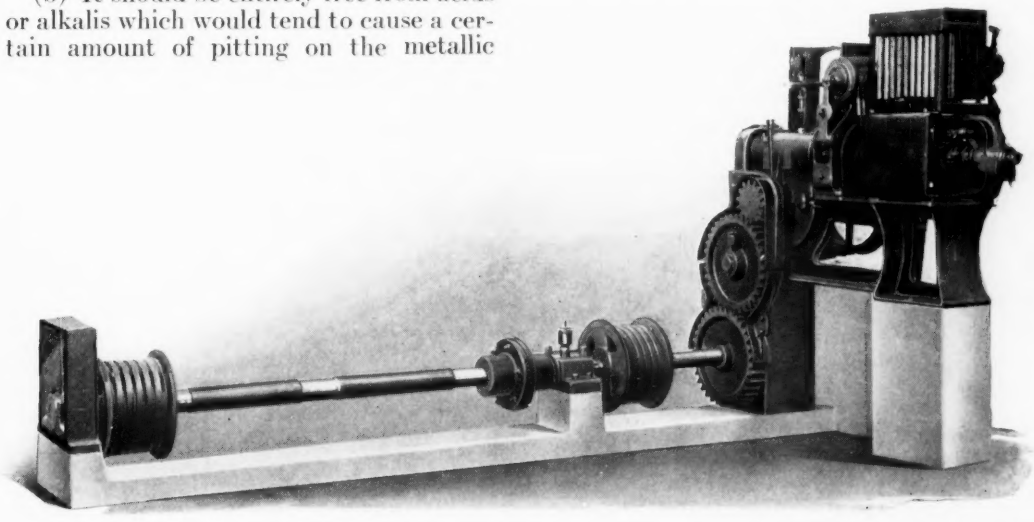
Many contend that the oil should be a pure mineral product with no animal or vegetable oils compounded therewith; the objection being that under the excessive pressures and temperatures which prevail the latter would have a tendency to break down, gum and clog the roller or ball thrust bearings.

For such purposes they recommend the use of a high grade steam refined cylinder stock having a flash point around 600° F. and a viscosity of about 150 seconds Saybolt at 210° F.

Most modern practice is, however, to use a pure mineral oil having a viscosity around 120 seconds Saybolt at 210° F., but with a pour test much lower than that of cylinder stock.

Oil Level Important

The level at which the lubricant should be carried in a worm gear case is important. Normally this should not be higher than the center of the worm shaft, and where possible only the teeth should dip into the oil.



Courtesy of A. B. See Elevator Co.

Fig. 12—Showing details of a sidewalk hoisting machine. Note reduction gears. Such equipment is usually located below the car, with provision for four-corner drive.

With some oils, this is all that is necessary. Thus the only oil to reach the gear teeth is carried around by the worm. In modern construction it is customary to control the height of oil in the gear case by the installation of an external overflow in the base.

The gear, running at relatively high speed, throws any excess oil to the side of the casing where it runs down, either back to the reservoir, or to lubricate the gear bearings, which in some installations are fitted with ring or chain oilers as well. The idea of running the worm fully submerged in oil is usually wrong.

The action of the worm is similar to that of a screw pump, hence the resultant high pressure to which the oil is subjected would tend to cause excessive leakage along the shaft. To guard against this, a grease cup is installed on the stuffing box in many installations. A seal of heavy lubricant is thereby obtained and at the same time, the shaft is properly lubricated.

For such purposes a relatively heavy grease is recommended. Normal good practice in the

absence of grease lubrication, allows for a very slow rate of oil leakage from the rear stuffing box of the worm shaft, to insure sufficient lubrication of the latter.

Sheave and Bearing Lubrication

The driving sheave bearing should be lubricated with the same oil as the worm gear where possible. This shaft is common to the main gear shaft and is subject to high pressures. Hence the requirement of a heavier bodied lubricant than for other sheave bearings.

On the other hand, the efficiency of the entire machine should never be jeopardized in an effort to stick to one oil only. If the gear lubricant is such as to be unsuitable for certain bearings, a separate oil such as a 500 or 750 viscosity engine oil should be used.

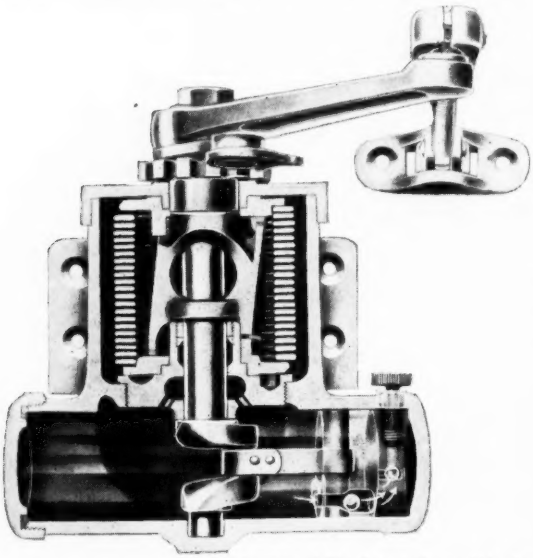
Lubrication of counterweight guides, brake mechanisms and other minor external wearing parts involves no difficulties. The matter of guide lubrication has been discussed under Hydraulic Elevators.

Other points such as rollers, brake parts, governor, etc., can either be lubricated by hand or sight feed oil cups, using the same oil as on the motor bearings. Certain installations include grease cups or pressure grease fittings for this purpose, in which event a light or medium bodied compression grease will be found very satisfactory.

Safety devices, such as the roller wedge block type, etc., while normally inoperative, should be regularly inspected and lubricated so as to insure prompt and efficient operation if required to function.

Automatic Door Closers

Another type of equipment which is extensively employed in the average office building is the automatic or hydraulic door closer. From a constructional point of view this device involves a spring of comparatively high tension suitably connected to a reciprocating element which is designed to act against hydraulic pressure. This latter is brought about by a charge of light lubricating oil.



Courtesy of The Yale & Towne Mfg. Co.

Fig. 13—Sectional view of an automatic door closer, showing cylinder, piston, connecting rod, valves, ports, and bearings, which embody hydraulic action. A light lubricating oil can be used for this purpose.

In operation, as the spring is wound up by opening of a door, the piston is moved a proportional distance within its containing cylinder, the charge of hydraulic fluid being drawn in via a suitable foot valve.

When the door starts to close by reason of the action of the spring, the plunger is pressed against this mass of fluid.

Inasmuch as escape of the latter can occur but slowly due to the size and construction of the release orifice, the door is closed at an even decrease of momentum without jerking or noise, and not too rapidly as to cause injury.

In the selection of a suitable grade of hydraulic fluid for use in such equipment there are two characteristics which must be borne in mind, viz.:—The viscosity or relative degree of fluidity, and the pour test. In other words whatever the temperature, such a fluid must be capable of ready circulation through the mechanism involved, and never subject to congealing or freezing.

Light lubricating oils of approximately 100 seconds Saybolt viscosity at 100° F. with a pour test in the neighborhood of zero, will in general be best suited to the conditions of operation in the average commercial building.

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